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EVALUATION OF SANURIL
WASTEWATER CHLORINATOR

RESEARCH BRANCH
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ABSTRACT

SANURIL Wastewater Chlorinator was developed for chlorinating treated effluents from small package type of sewage treatment plants with daily capacity up to 50,000 U.S. gal/day. It is basically a simple dissolving apparatus for dispensing chlorine from SANURIL 115 tablets which consist of stabilized calcium hypochlorite.

Field tests at three sewage treatment plants have indicated that the SANURIL chlorination system was capable of providing more than adequate levels of chlorine residuals to achieve satisfactory disinfection in the plant effluent. Its major problem was that the SANURIL 115 tablets had a tendency to dissolve prematurely and release excess amounts of chlorine. This resulted in needlessly high levels of chlorine residuals in the chlorinated effluents. Because of this, the chlorinator could not be operated more than 3 or 4 days at a given flow rate without exhausting the chlorine tablets in fully charged feed tubes in contrast to a period of weeks as suggested by the manufacturer. It was necessary to keep a closer check on this system in order to insure that there was a continuous supply of chlorine tablets in the chlorinator.

INTRODUCTION

One of the most popular methods for disinfecting treated effluents from small package sewage treatment plants is by chlorination through the application of calcium or sodium hypochlorite. The disinfecting chemical is prepared as a dilute aqueous solution in a storage tank and injected in appropriate dosages into the plant effluent by means of a chemical feeder. This technique requires daily preparation of chlorine solution and regular maintenance of the feeder to insure proper disinfection of the sewage effluent. The chemical feeders are generally activated by electrically powered pumps and they are only capable of delivering chlorine solutions at constant rate. For this reason, it is difficult to maintain optimum levels of chlorine in the sewage effluents which are subject to fluctuating flow rates and ever changing chlorine demands.

Gaseous chlorine is rarely used in the disinfection of effluents from small package sewage treatment plants because of the high capital costs involved in providing the feed equipment and other auxiliary facilities needed to insure the safe handling of the toxic gas. Gas chlorinators must be installed in a separate room equipped with an exhaust fan.

Recently, a simple chlorination system has been developed by the Diamond Shamrock Corporation for use in the disinfection of effluents from small package sewage plants. This is known as the SANURIL Wastewater Chlorinator and is designed to dispense

chlorine from specially formulated sanitizing tablets. Some of the features claimed for this system are that it is simple, adjustable, and operates continuously for weeks without any attention. It has no moving parts and needs no power, mixing devices, solution tanks nor pumps, hence its maintenance requirements are minimal. In addition, it is claimed to be capable of maintaining a fixed initial concentration of chlorine in the effluent despite the normal fluctuations in flow rates.

It is the purpose of this report to present a summary of data and results of various laboratory and field tests which were conducted to evaluate the performance of the SANURIL Wastewater Chlorinator in the disinfection of treated effluents from small sewage treatment plants.

DESCRIPTION OF THE SANURIL CHLORINATION SYSTEM

The main active disinfecting agent is SANURIL 115, a chemical compound developed and formulated by the Diamond Shamrock Corporation specifically for sanitizing sewage effluents from package sewage treatment plants. It is a combination of calcium hypochlorite and 1,3,4,6 tetrachloro-glycoluril formed into a solid tablet measuring 2-5/8 in. in diameter by 13/16 in. thick. Each tablet weighs 4-1/2 oz. and its bulk density is 83 lb. per cu. ft. Because of its ingredients, the SANURIL 115 tablet is claimed to possess certain inherent properties which make it superior to the commercially available chlorine compounds for sewage disinfection. It is said to dissolve evenly and slowly without disintegrating when placed in a stream of water. Its germicidal potency is said to be superior to that of either calcium or sodium hypochlorite.

SANURIL 115 tablets were developed for use with the SANURIL Wastewater Chlorinator (henceforth referred to as the "chlorinator"). As shown in Figure 1, the chlorinator consists basically of a rectangular box with an overall dimension of 21-3/4 in. long, 13-1/4 in. wide and 13-1/4 in. deep. It is fitted with a short 6 in. diameter intake pipe at one end to permit the inflow of treated effluent. It has two slots to hold a removable weir plate at the outlet. By regulating the height of the liquid flow in the chlorinator, the weir plate controls the dissolving rate of the chlorine tablets.

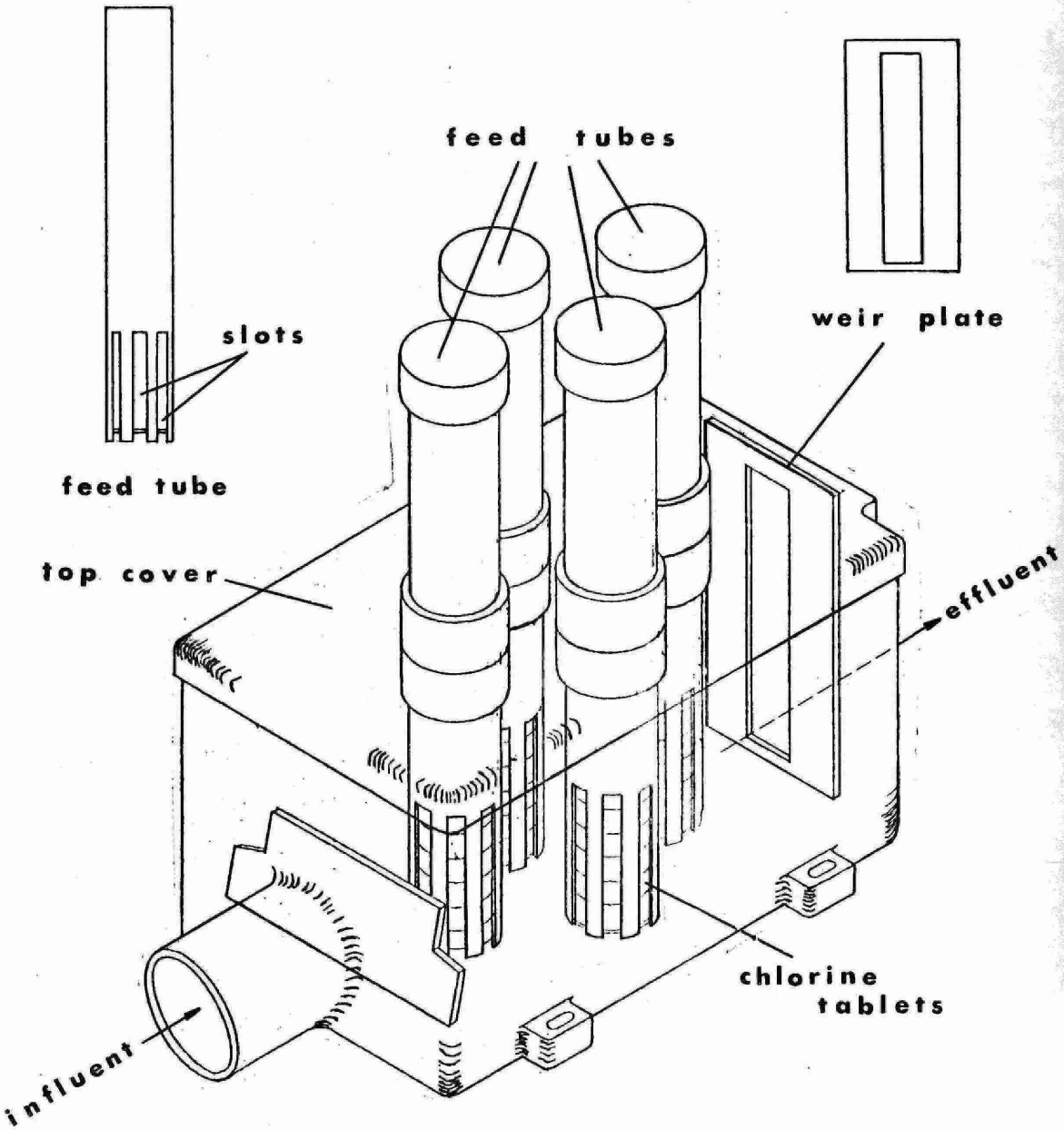

Figure 1

Diagram of SANURIL Wastewater Chlorinator

The chlorinator is fitted with a removable cover with four openings through which the feed tubes can be inserted. Each feed tube is 3-1/2 in. outside diameter with a removable cap and slotted at the other end to permit the free flow of water. Each tube is 24 in. long and can hold twenty-nine chlorine tablets.

The chlorinator with all of its components is fabricated from moulded fiberglas and polyvinyl chloride materials to provide durability and resistance to corrosion.

INSTALLATION AND OPERATION

The chlorinator can be readily installed in any sewage treatment plant in which there is sufficient space available to permit its proper mounting. Ideally, it should be placed at a point where the entire plant flow can be channelled or passed through the unit before entering the chlorine contact tank. More detailed instructions can be found in the "Instruction Manual".*

When a stream of treated sewage flows into the chlorinator through the inlet pipe and passes the feed tubes charged with chlorine tablets, the chemical dissolves and releases the chlorine into the wastewater. The amount of chlorine released depends upon the height of the water level in the chlorinator and this, in turn, is controlled by a removable rectangular slot weir which inserted at the outlet of the chlorinator. With an increase in the flow rate, there is a corresponding rise in the water level in the chlorinator and this exposes a greater number of chlorine tablets to the sewage through the slotted ends of the feed tubes. This allows more chemical to dissolve and thus releases more chlorine into the wastewater.

The stream with the chlorine added flows out from the chlorinator into the chlorine contact tank to allow sufficient period of time for the action of the chlorine to take effect.

Although the test model of the chlorinator used in this study was furnished with four feed tubes and rectangular slot weirs of three sizes, the actual number of tubes to be

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* SANURIL Wastewater Chlorinator Instruction Manual Bulletin R-SL-2. Diamond Shamrock Corporation.

filled with the chlorine tablets and the weir to be used are determined by the flow rate of the sewage and the chlorine residual desired. This can be found in the "Instruction Manual".

FIELD TESTS

The field tests for the evaluation of the SANURIL Wastewater Chlorinator Model 1000 were conducted at the sewage treatment plants which serve the communities of Brampton, Erindale and Unionville, located in the suburban areas of Metropolitan Toronto. All three plants employ the conventional activated sludge process involving primary and secondary treatment followed by chlorine disinfection.

Unionville Sewage Treatment Plant

The chlorinator was first tested at the Unionville sewage treatment plant which handles almost entirely domestic sewage. Its daily flows ranged from 80,000 to 150,000 gpd* with the peak periods occurring at approximately 8:00 a.m. and 6:00 p.m.

The chlorinator was installed in the flow channel where the clarified effluent flows from the secondary clarifier into the chlorine contact tank. Since the plant flows were subjected to wide fluctuations, it was necessary to insert a baffle in the channel to by-pass any volume in excess of 50,000 gpd from the chlorinator.

Shortly after the first test it was found that the chlorine tablets seemed to dissolve very rapidly and disappear prematurely. A fully charged feed tube containing 29 chlorine tablets placed in the chlorinator in accordance with the directions presented in the Instruction Manual was found completely empty on two occasions when checked in the morning after it had been in service from the previous day. The results of another test showed

* Imp. gal. used throughout unless indicated otherwise.

that the dissolving rate was at least one tablet per hour from a fully charged feed tube placed in the chlorinator fitted with a 3-in. weir plate to treat a flow of approximately 40,000 to 60,000 gpd.

A further test was conducted in the laboratory to observe the dissolving patterns of a single tablet immersed in a beaker with flowing water. The latter was introduced by means of a tube along the bottom of the beaker so that there was a gentle swirling action created around the tablet. The tablet did not appear to dissolve very evenly but seemed to break off in small flaky particles measuring 2 to 5 mm. The surface of the tablet exposed to the turbulence seemed to be more susceptible to erosion.

Further tests with this lot of SANURIL 115 tablets were terminated upon the advice of the representative from the Diamond Shamrock Corporation. It was also decided to suspend any further tests at the Unionville plant and seek another site where the effluent flow through the SANURIL Chlorinator can be better controlled and measured.

Brampton-Chingacousy Water Pollution Control Plant

The above sewage treatment plant was selected for the second series of tests using a new batch of SANURIL 115 tablets obtained from the supplier. This plant received daily flows of over 6 mgd consisting of both domestic sewage and industrial wastes. These tests were conducted during November and December, 1971.

In order to overcome some of the shortcomings experienced at the Unionville plant, these tests were carried out under controlled flow conditions. A large weir box with a 90° V-notch weir plate was constructed to regulate the flow through the chlorinator. As shown schematically in Figure 2, the effluent was pumped from the secondary clarifier through a flow meter into the weir box. The effluent then flowed by

gravity from the weir box into the chlorinator and discharged into the chlorine contact tank. The flow was regulated by means of a valve installed in the line from the pump.

After a preliminary run, it was found that only one feed tube charged with tablets was sufficient to provide an adequate amount of chlorine to the sewage effluent. The weir plate was selected on the basis of information provided in the "Instruction Manual".

Erindale Sewage Treatment Plant

The third series of field tests was conducted at the Erindale sewage treatment plant during May and June, 1972. This plant handles approximately 0.5 mgd of entirely domestic sewage. The chlorinator was set up there in the same manner as at the Brampton-Chingacousy WPCP. The effluent from secondary clarifier was pumped up into the weir box from where it flowed by gravity into the chlorinator and discharged into the chlorine contact tank. Three batches of SANURIL 115 tablets were evaluated. The third batch of tablets was received from the supplier during May, 1972. In addition, the total volumes of sewage through the chlorinator were measured.

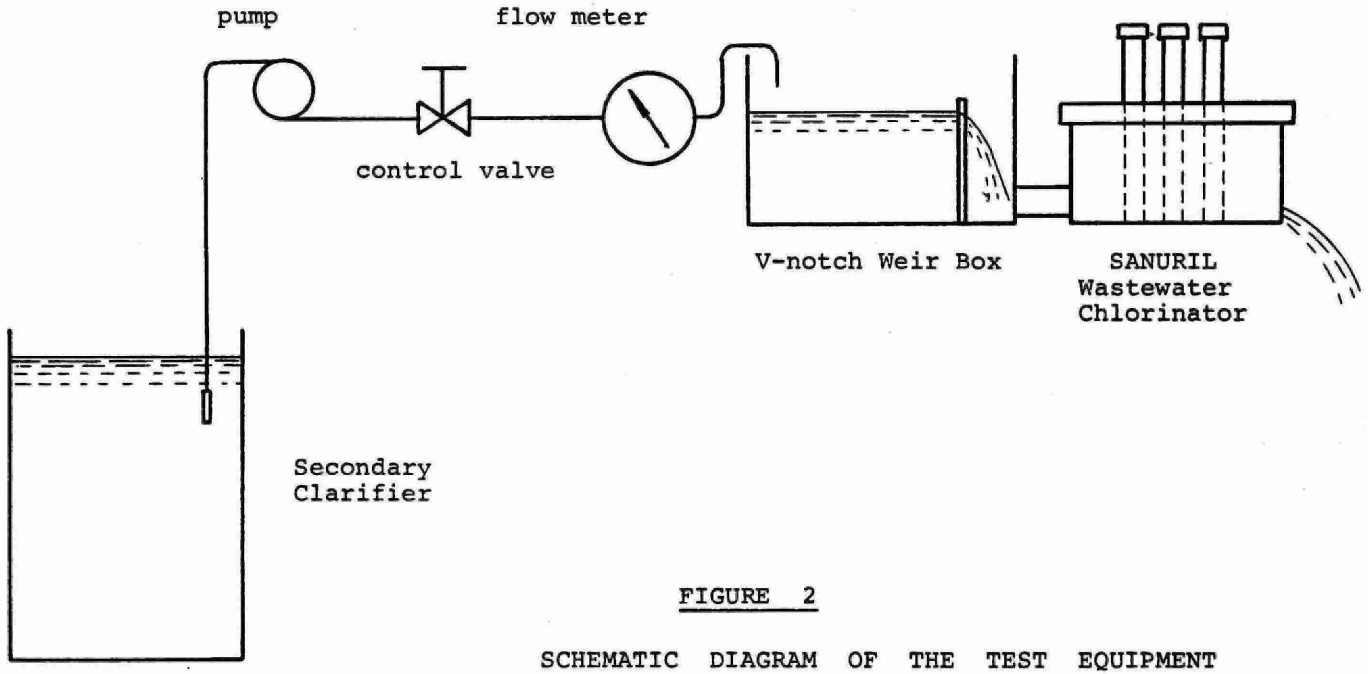

FIGURE 2

SCHEMATIC DIAGRAM OF THE TEST EQUIPMENT

TO EVALUATE THE SANURIL WASTEWATER CHLORINATOR

RESULTS AND DISCUSSION

Field Tests at Brampton-Chingacousy WPCP

Field data collected from the test runs at the above sewage treatment plant are summarized in Table 1. Bacteriological analyses of the samples obtained during these tests are recorded in Table 2.

In all of these tests, it was decided that meaningful data could only be obtained from test runs which were conducted continuously over a period of several days or at least twenty-four hours. Because these tests were conducted outdoors during November and December, there was always a danger of frost damage due to low night time temperatures. For this reason, the flow rates reported in Table 1 and 2 are approximated. At the beginning of each run, the flow of sewage effluent through the chlorinator was measured and established at the given rate by means of flow meter and a stopwatch. The meter was then removed and the flow through the chlorinator was maintained at the established rate with the use of a weir box.

The chlorine demand tests were performed in accordance with the procedures as outlined in the STANDARD METHODS for the Examination of Water & Wastewaters, 12th edition. The chlorine residuals were measured in the samples after holding for 15 minutes using the ortho-tolidine indicator and a Wallace & Tiernan comparator.

The consumption of the SANURIL 115 tablets was determined by calculations using the data provided by the supplier and the measured changes in the levels of the tablets in the feed tube during the test period.

A sample calculation is shown below.

Sample Calculations for Tablet Consumption

Change in the level of tablets in the feed tube (determined by measurement) - 3-7/8 (3.875) in.

Thickness of each tablet - 13/16 (0.8125) in.

Number of tablets consumed - $\frac{3.875}{0.8125} = 4.8$

Weight of each tablet - 4.5 oz.= $\frac{4.5}{16}$ lb.

Total weight of tablets consumed - $\frac{3.875}{0.8125} \times \frac{4.5}{16} = 1.3$ lb.

Estimated Throughput - 31,000 Imp. gal/day

Consumption Rate of Tablets - $\frac{1.3 \times 1000}{31,000} = 0.0433$ lb/1000/gal.

The data in Table 1 indicate that the consumption rates of the chlorine tablets measured in terms of lbs/1000 gal. were found to be higher at increased flow rates. At flows of 42,000 gpd. the consumption rate was well over 0.065 lb/1000 gal. as compared to about 0.43 to 0.49 lb/1000 gal. at 30,000 - 31,000 gal. per day.

It was found that tablets had a tendency to dissolve very rapidly. A feed tube containing 29 tablets lasted no more than three days at flows of 42,000 gal/day. One run at 15,000 - 20,000 gal/day lasted approximately 9 days. Tablet consumption during this period was estimated to be 0.02 to 0.033 lb/1000 gal.

TABLE 1

RESULTS OF FIELD TESTS AT BRAMPTON-CHINGACOUSY WATER POLLUTION CONTROL PLANT [4]

DATE 1971	FLOW RATE [1] gal/day	WEIR PLATE inch	DEMAND [2]	RESIDUAL [3]	TEST PERIOD hours	TABLET NUMBER	TABLET WEIGHT lb.	CONSUMPTION RATE lb/1000 gal
Nov. 23-24	33,000	2	6.2	0.75	24	4.6	1.3	0.039
24-25	31,000	2	5.7	0.75	24	4.7	1.4	0.043
25-26	30,000	2	4.5	0.75	32	6.6	1.9	0.049
26-28	33,000	2	5.8	1.2	46	13	3.7	0.058
Nov.29-Dec.8	15,000-20,000	2	4.8-5.8	0.5-0.75	9 days	14	3.9	0.024-0.033
Dec. 8-11	42,000	3	3.9	1.4	3 days	29	8.2	0.065
12-13	42,000	3	4.6	1.0	24	12	3.4	0.081
13-14	42,000	3	-	1.4	24	9.7	2.7	0.064

NOTES:
1. Flow rate is estimated and reported in Imp. gal. 1 Imp gal. = 1.2 US gal.
2. 15-minute chlorine demand
3. Chlorine residuals were measured after 15 minutes with a Wallace & Tiernan chlorine comparator.
4. Tests conducted with the second lot of SANURIL 115 tablets received from Diamond Shamrock Corporation during November, 1971.

TABLE 2

EFFECTIVENESS OF SEWAGE DISINFECTION WITH THE SANURIL CHLORINATOR

(Field Tests at Brampton-Chingacousy W.P.C.P.)

Date	Flow Rate[1] gal/day	Weir Plate Used	Sample	Chlorine Demand[2]	Chlorine Residual[3]	Coliforms/100 ml Total	Coliforms/100 ml Fecal
Nov. 24/71	25,000	2"	untreated	5.7	-	1.6×10^5	2×10^4
			treated* [4]	-	0.75	10	10
			treated	-	0.75	1.65×10^5	2×10^3
Nov. 28/71	20,000	2"	untreated	5.8	-	1.1×10^6	-
			treated*	-	0.45	10	-
			untreated		0.45	1.5×10^3	-
Dec. 6/71	20,000	2"	untreated	4.9	-	1.13×10^5	6×10^3
			treated*	-	0.5	10	10_3
			treated	-	0.5	1.2×10^5	10^3
Dec. 8/71	42,000	3"	untreated	4.8	-	1.7×10^5	1.2×10^3
			treated*	-	1.0	10	10
			treated	-	1.0	10	10
Dec. 10/71	42,000	3"	untreated	3.9	-	9.3×10^4	10^3
			treated*	-	1.2	10	10
			treated	-	1.2	10	10

NOTE:
1. Flow rate was estimated and reported in Imp. gal.
2. 15-minute chlorine demand.
3. Chlorine residuals were measured after 15 minutes with a Wallace & Tiernan comparator.
4. Treated samples were collected in two sterilized bottles; one of which contained sodium thiosulphate (marked with an asterisk) to neutralize effects of residual chlorine.

The measured levels of chlorine residuals in the effluent were found to be considerably higher at higher flow rates. At flows of 15,000 - 20,000 gal per day, the chlorine residuals were in the order of 0.5 to 0.75 mg/l while at 42,000 gal/day, they were consistently well over 1.0 mg/l.

Efficiency of Disinfection

Table 2 shows the results of bacterial analyses as well as flow rates, chlorine demands and chlorine residuals related to the samples collected during the test runs.

To evaluate the effectiveness of disinfection by the SANURIL tablets, two bacterial samples of the treated effluent were collected simultaneously from the chlorinator. One of the samples was taken in a sterilized bottle and the other in a sterilized bottle containing sodium thiosulphate to neutralize and arrest the action of any residual chlorine present.

The results show that nearly all of the sewage organisms were satisfactorily destroyed in the samples collected in the bottle without any sodium thiosulphate. Since these samples were collected at the outlet of the chlorinator, there were only a few seconds of contact after chlorination. Hence, nearly all of the samples collected in bottles with the neutralizing agent showed only negligible reduction in the number of the coliform organisms destroyed. Significant destruction was noted only in the samples which indicated chlorine residuals over 1.0 mg/l after 15 minutes.

Field Tests at Erindale Sewage Treatment Plant

The chlorinator was evaluated at the Erindale sewage treatment plant with three lots of SANURIL 115 tablets. Two of these were received during 1971 and left over from the previous tests at Brampton-Chingacousy and Unionville plants. The third was a new lot of tablets obtained from the Diamond Shamrock Corporation during May, 1972. The data and the results of these tests are compiled in Tables 3 and 4.

During these tests, a totalizer water meter was installed permanently with the test equipment to record the total volume of effluent flowing through the chlorinator for each of the runs. As in the previous tests at the Brampton-Chingacousy plant, each run was started at a given flowrate and allowed to continue unattended for at least 24 hours. The consumption rate of the chlorine tablets was also calculated in a similar manner using the measurements of level changes in the feed tube. (See page 13)

A comparison in the consumption rates of the chlorine tablets from the three lots can be made by examining the data compiled in Tables 3 and 4 during the runs while the chlorinator was operating with design flows of 41,650 gal/day (50,000 U.S. gal/day). It can be seen that these tablets did not dissolve at a consistent rate but varied with each lot. According to the calculated data, the first lot of tablets were consumed at the rate of 0.091 lb/1000 gal. In each case, the chlorinator was operated using a 3-inch weir plate and a single feed tube charged with the chlorine tablets. The chlorine residuals in the treated effluent after a 15-minute contact time were found to be in excess of 1.0 mg/l with an average value of 1.5 mg/l.

TABLE 3

RESULTS OF FIELD TESTS AT ERINDALE SEWAGE TREATMENT PLANT

DATE	FLOW RATE gal/day	THROUGHPUT gal.	WEIR PLATE inch	CHLORINE DEMAND mg/l	CHLORINE RESIDUAL mg/l	TABLET CONSUMPTION NUMBER	TABLET CONSUMPTION WEIGHT lb.	TABLET CONSUMPTION RATE lb/1000 gal.
			TESTS WITH 2ND LOT OF SANURIL 115 TABLETS					
May 10	41,650	40,240	3	1.6	1.2	11.1	3.12	0.078
" 10-12	41,650	87,340	3	1.8	1.0-1.5	24.5	6.8	0.078
" 13	24,990	23,400	3	-	0.5	4.0	1.1	0.047
			TESTS WITH 1ST LOT OF SANURIL 115 TABLETS					
May 14	41,650	41,300	3	2.0	1.2	13.3	3.75	0.091
" 15	24,990	23,580	3	-	0.75	6.8	1.9	0.068
" 16-18	24,990	41,100	3	-	0.5-1.0	16	4.5	0.091

NOTE: - Volumes are reported in Imperial gals.

TABLE 4

RESULTS OF FIELD TESTS AT ERINDALE SEWAGE TREATMENT PLANT

TESTS WITH 3RD LOT OF SANURIL 115 TABLETS [1]

DATE	FLOW RATE gal/day [2]	THROUGHPUT gal. [2]	WEIR PLATE inch	CHLORINE DEMAND mg/l	CHLORINE RESIDUAL mg/l	TABLET CONSUMPTION NUMBER	TABLET CONSUMPTION WEIGHT lb	TABLET CONSUMPTION RATE lb/1000 gal.
May 25	41,650	70,000	3	2.5	1.2	27	7.6	0.109
28	41,650	36,500	3	-	1.4	14	3.9	0.109
29	41,650	37,700	None	2.8	1.0	10.3	2.9	0.077
30	41,650	41,900	None	-	1.2	12	3.3	0.081
June 12	20,800	23,500	2	2.4	0.75	6.3	1.8	0.075
" 13-15	20,800	42,000	3	-	0.35	8.8	2.5	0.060
" 16 [3]	20,800	18,500	3	2.4	0.35	2.7	0.76	0.041

NOTES:
1. Manufacturer's Lot No. 6400-5
2. Imperial Gallon
3. During this run, the inactive feed tubes were installed with the slotted end down against the bottom of the chlorinator.

Even at a lower flow rate, there was a significant difference noted in the dissolving rates between the lots of the tablets. For example, at a flow of 24,990 gal/day (30,000 U.S. gal/day), the first lot of tablets was consumed at a calculated rate of 0.068 lb/1000 gal while the second lot was used at the rate of 0.047 lb/1000 gal.

During the two-day run (May 16-18) when the chlorinator was operated at 24,990 gal/day flow, the tablets appeared to dissolve more rapidly as compared to the previous run of May 15th. The calculated consumption rate rose from 0.068 lb/1000 gal to 0.091 lb/1000 gal.

According to the Instruction Manual (Bulletin R-SL-2), the chlorinator using the combination of a 3-in. weir plate and one charged feed tube should be capable of operating approximately 25 days without a refill on a daily plant flow of 50,000 U.S. gal. In a study conducted elsewhere*, a similar system was reported to operate at least 15 days before refilling at the 50,000 U.S. gal/day rate. However, in the tests conducted by the Research Branch staff, it was found impossible to obtain more than 3 or 4 days of service from the similar system operating at equivalent flow rates on all three lots of tablets.

Operation Without the Weir Plate

Because it was obvious that the chlorine tablets were dissolving prematurely, it was decided to modify the operation of the chlorinator. It was thought that by removing the weir plate, the liquid level in the chlorinator would be lowered thus exposing fewer chlorine tablets in the

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* Development of the SANURIL(TM) System - An Improved Method for Disinfecting Treated Sewage - Diamond Chemicals Techni-Bulletin, Diamond Shamrock Corp. Feb. 10/71.

feed tubes. This, in turn, would help to lower the consumption rate of the chlorine tablets.

The results from two runs conducted May 29 and 30 (Table 4) at the design flow of 41,650 gal/day demonstrated that tablet consumption can be substantially reduced while maintaining satisfactory levels of chlorine residuals in the treated effluent. The tablet consumption with the chlorinator operating without any weir plate was found to be 0.077 to 0.081 lb/1000 gal as compared to 0.109 lb/1000 gal with the use of a 3-inch weir plate. Table 4 also includes results from a series of tests conducted with the effluent flow reduced to 20,8000 gal/day (25,000 U.S. gal/day) through the chlorinator using 2-inch and 3-inch weir plates. The consumption rates of the chlorine tablets were foun d to be 0.075 lb/1000 gal and 0.060 lb/1000 gal respectively. By increasing the size of the weir plate from 2-inch to 3-inch opening, there was also a reduction in the levels of chlorine residuals from 0.75 mg/l to 0.35 mg/l. Bacterial samples collected from the effluent with a lower chlorine residual indicated satisfactory disinfection (Table 5).

The results of June 16th run showed that the consumption rate of the chlorine tablets can be reduced further by operating the chlorinator with all of its inactive feed tubes inserted with slotted ends down against the bottom.

Efficiency of Disinfection

The bacteriological data collected from the field tests at the Erindale sewage treatment plant are presented in Table 5. It should be noted that all of the chlorinated samples were collected in special sterilized bottles containing sodium thiosulphate to arrest the action of any residual

chlorine present. The procedure for taking these samples is as follows:

> A large volume (1 to 2 litres) of the treated effluent was obtained from the outlet of the chlorinator in a large beaker or a graduated cylinder. It was held for the indicated time of contact and then transferred to the sterilized bottles for coliform analyses.

The results in Table 5 show that there was very good disinfection effected in nearly all of the samples, which exhibited satisfactory levels of chlorine residuals. The only sample showing unsatisfactory results was found to be the one having a contact time of only 0. 5 minutes (June 14).

On May 31st, tests were conducted to evaluate the performance of the chlorinator operating under over-loaded flow conditions. This run was started at the design flow rate of 41,650 gal/day. The chlorine residuals were measured several times during the run and they were found to level off to approximately 0.75 mg/l.

The bacteriological analyses of several samples collected during this run indicated that there was no loss in the efficiency of disinfection even though some of the samples were subjected to much shorter contact periods than the usual 15 minutes. The results show that the chlorinator operating at its initial application rates will provide adequate disinfection to sewage effluent increased by 50 per-cent above its design flow.

The chlorinator was also evaluated when operating under low flow conditions using the 3-inch weir plate inserted at its outlet. The bacteriological data recorded for June 14th show that satisfactory disinfection was achieved in nearly all of the samples. Poor results were noted in the sample which had a contact time of only 0.5 minutes. The chlorine residuals in all of these samples were found to be in the order of 0.35 to 0.5 mg/l.

TABLE 5

EFFECTIVENESS OF CHLORINE DISINFECTION WITH THE SANURIL CHLORINATOR

(Tests at Erindale Sewage Treatment Plant)

DATE 1972	FLOW RATE gal/day	WEIR PLATE USED	SAMPLE	CHLORINE RESIDUAL mg/l	CONTACT PERIOD min.	COLIFORMS/100 ML TOTAL	COLIFORMS/100 ML FECAL
May 28	41,650	3"	untreated	-	-	1.2×10^5	6.12×10^5
			treated	1.0	5	790	40
			treated	1.0	15	<10	<10
May 29	41,650	None	untreated 1	-	-	3.4×10^5	1.1×10^5
			2	-	-	6.0×10^5	1.4×10^5
			treated	1.0	2	<10	<10
			treated	1.0	5	<10	<10
			treated	1.0	10	<10	<10
May 30	41,650	None	untreated 1	-	-	1.08×10^5	0.33×10^5
			2	-	-	1.06×10^5	0.36×10^5
			treated	0.75	15	<10	<10
			treated	1.0	15	<10	<10
May 31	41,650	None	untreated 1	-	-	1.2×10^5	0.13×10^5
			2	-	-	0.7×10^5	0.06×10^5
			treated	1.0	0.5	30	<10
			treated	1.0	5	<10	<10
			treated	1.0	15	<10	<10
	60,000	None	treated	0.75	0.5	20	<10
					5	<10	<10
					15	<10	<10
June 14	20,800	3"	untreated	-	-	1.08×10^5	
			treated	0.35 - 0.5	0.5	0.98×10^5	
			treated	0.35 - 0.5	5	<10	
				0.35 - 0.5	10	<10	

Table 6

Chemical Analysis of the Final Effluent

	Brampton-Chingacousy	Erindale
Chlorine Demand	3.9 - 6.2	1.6 - 2.8
B.O.D.	12 - 20	22 - 60
C.O.D.	50 - 65	-------
Nitrogen		
Ammonia	18 - 20	20 - 25
Kjeldahl	21 - 25	25 - 29
Nitrate	0.06 - 0.3	0.17- 2.6
Nitrite	0.18 - 0.4	0.12 - 2.3
pH	7.7 - 7.9	7.1 - 7.3
Solids, Total	575 - 625	520 - 610
Dissolved	560 - 595	510 - 600
Suspended	8.5 - 15	10 - 15

Note: These results represent a range of values obtained by the analyses of grab samples collected during the tests. The number of samples were as follows:

Brampton-Chingacousy - 6

Erindale - 4

Effluent Quality

The chemical analyses of the final effluent collected as grab samples during the test runs at the Brampton-Chingacousy and Erindale sewage treatment plants are tabulated in Table 7. The results show that the final effluent from the Brampton-Chingacousy plant had higher chlorine demand than that from the Erindale plant. However, the BOD of the effluent from the Brampton-Chingacousy plant was found to be generally lower than that of the Erindale plant.

COMPARATIVE GERMICIDAL EFFECTIVENESS OF SANURIL 115

In one of the information bulletins (Bulletin R-SL-3) supplied with the equipment, Diamond Shamrock Corporation has presented some convincing data to demonstrate that the germicidal potency of SANURIL 115 tablets is superior to that of either sodium hypochlorite or calcium hypochlorite, the two chlorine compounds which are commonly employed in the disinfection of sewage effluents.

A series of laboratory tests were conducted to investigate the validity of this claim. The details and the results of this study are summarized in Table 8. Each test was conducted simultaneously under controlled conditions with samples of sewage dosed with appropriate amounts of each chemical to yield approximately the same level of chlorine residual after a 15-minute contact period.

The germicidal effectiveness of each chlorine compound can be compared by examining the bacterial quality of the treated samples as shown in Table 8. It should be noted that two sets of bacterial samples were collected during this study. Samples marked 'A' were collected in sterilized bottles containing sodium thiosulphate while those marked 'B' were taken in the usual sterilized bacterial bottles. By arresting the action of residual chlorine within the prescribed time of contact with sodium thiosulphate, it is possible to assess and compare the affects of disinfection by each of these chlorine compounds.

The bacteriological data collected from Test No. 1 show comparative effects of chlorination by the three chemicals at 1.0 mg/l

TABLE 7

COMPARISON OF GERMICIDAL EFFECTIVENESS OF SANURIL 115 AND OTHER HYPOCHLORITES

BASED ON BACTERIOLOGICAL ANALYSES

	pH	TEMP ^{0}C	Cl_2 RESIDUAL [2]	FECAL COLIFORMS [3]		COLIFORM BACTERIA [3]		TOTAL PLATE COUNTS [3]	
				A	B	A	B	A	B
TEST NO 1									
SANURIL 115	8.1	11.5	1.01	28	< 4	12,000	44	4,600	400
CALCIUM HYPOCHLORITE	8.1	11.0	1.05	40	< 4	7,900	56	350,000	300
SODIUM HYPOCHLORITE	8.0	11.2	0.98	32	< 4	11,500	76	560,000	600
TEST NO 2									
SANURIL 115	8.1	16.0	0.74	12	< 4	9,500	88	870,000	300
CALCIUM HYPOCHLORITE	8.1	15.3	0.69	36	< 4	18,000	152	470,000	2300
SODIUM HYPOCHLORITE	8.1	15.0	0.71	174	< 4	22,400	160	780,000	400
TEST NO 3									
SANURIL 115	8.0	16.5	0.38	90	10	15,800	330	930,000	2100
CALCIUM HYPOCHLORITE	8.0	17.0	0.42	230	10	17,800	210	1,690,000	700
SODIUM HYPOCHLORITE	8.0	16.5	0.41	70	20	19,800	280	2,210,000	800
SECONDARY EFFLUENT [4]	8.0			8,300 4,200		1.1×10^5 1.0×10^5		6.5×10^6 4.9×10^6	

NOTES: 1. SUFFICIENT CHLORINE SOLUTION WAS ADDED TO EACH SAMPLE TO PROVIDE FOR A CHLORINE RESIDUAL (15 MINUTES) OF 1.0 MG/1 IN TEST NO. 1
0.75 MG/1 IN TEST NO. 2
0.5 MG/1 IN TEST NO. 3

2. CHLORINE RESIDUALS WERE MEASURED AFTER A CONTACT PERIOD OF 15 MINUTES WITH A FISCHER & PORTER AMPEROMETRIC TITRATOR

3. TWO SAMPLES WERE COLLECTED FOR BACTERIOLOGICAL ANALYSES AFTER 15 MINUTES. SAMPLE 'A' WAS COLLECTED IN A STERILIZED BOTTLE CONTAINING SODIUM THIOSULPHATE TO NEUTRALIZE ANY RESIDUAL CHLORINE.

4. SAMPLE OF SEWAGE EFFLUENT WAS OBTAINED FROM BRAMPTON-CHINGACOUSY WPCP.

chlorine residual after 15 minutes. It can be seen that the number of fecal and total coliforms surviving would show that the disinfecting effects of all three chemical are comparable. However, there was a marked reduction in the number of organisms indicated by the total plate counts in the sample treated by SANURIL 115.

The bacterial results from Test Nos. 2 and 3 indicate that despite the lower numbers of surviving organisms found in some of the sewage samples treated with SANURIL 115, there appeared to be no significant difference in the disinfection power of all three chemicals.

In general, it can be stated that the germicidal potency of SANURIL 115 was comparable and equivalent to, but no greater than, that of the other two disinfectant chemicals. Any differences exhibited by the bacteriological data were not considered to be significant but related to the limitation of experimental and analytical techniques.

COSTS

According to the representatives of Diamond Shamrock Corporation, the cost price at which the SANURIL 115 tablets and the SANURIL Wastewater Chlorinator will be sold in Canada has not yet been firmly established. It has been suggested that the chlorinator will probably sell for over $200.00 and the SANURIL tablets for $0.95 per lb.

Assuming a cost price of $0.95 per lb. and the chlorine content of 70 percent available chlorine in the SANURIL 115 tablets, the actual cost of chlorine is calculated to be $1.35 per lb. This is considerably higher than $0.75 per lb. for chlorine obtained from sodium hypochlorite solution with 12 percent available chlorine which is sold for $4.50 in 5 gal. containers. In small quantities, the cost of gaseous chlorine in 150 lb. cylinders is estimated to be $0.20 per lb. which is considerably lower than the cost of chlorine derived from the two chemicals.

Despite the wide ranges in the costs of chlorine derived from different chemicals, it would appear that the SANURIL wastewater chlorination system offers the simplest and the least expensive equipment for the treatment of effluents from small sewage plants. The use of sodium hypochlorite solution require a suitable chemical feeder and a large plastic or a ceramic tank of at least 25 to 30 gal. capacity in preparation and storage of the working solution. Total cost of this equipment is estimated to be about $300.00 to $400.00.

Because of its hazardous nature, the application of gaseous chlorine require the use of specialized gas handling

equipment at an estimated cost of $800.00. In addition, this equipment must be installed in a separate room equipped with an exhaust fan and other safety equipment.

In terms of cost and chemical content, chlorine derived from the SANURIL tablets is probably the most expensive in comparison with that from other chlorine compounds. For small sewage plants, where cost of chlorine is not considered to be significant in comparison to the cost of labour, power and maintenance, the SANURIL wastewater chlorinator represents a practical system because of its simplicity of operation.

SUMMARY AND CONCLUSIONS

SANURIL Wastewater Chlorinator is basically a dissolving apparatus to dispense chlorine into treated sewage effluents from tablets of stabilized calcium hypochlorite. This concept was developed by Diamond Shamrock Corporation for the disinfection of treated effluents from small package type of sewage treatment plants with daily flows up to 50,000 gal/day. (U.S. gal)

The chlorinator was set up for evaluation at three sewage treatment plants which employ the conventional activated sludge process. The results of these tests indicate that the SANURIL Wastewater Chlorinator, in principle, is a simple but viable method of chlorinating sewage effluents with proper installation and usage. It was found capable of providing more than adequate levels of chlorine to achieve satisfactory disinfection in treated sewage effluents. One of the major drawbacks is that the SANURIL 115 tablets have a tendency to dissolve very rapidly and release excess amounts of chlorine. This results in needlessly high levels of chlorine residuals in the chlorinated effluents. Because of this, the number of days of service yielded by the chlorinator between the refillings of the feed tube was only a small fraction of the time suggested by the manufacturer. This means that the system would require more frequent maintenance than expected.

The chlorinator proved to be capable of providing satisfactory levels of chlorine residuals and maintaining good disinfection under sudden surges of sewage flows up to 50 percent in excess of its design capacity.

The consumption rate of the chemical tablets was determined to be in the order of 0.024 to 0.11 lb. per 1000 gal. of sewage treated. Highest rates were noted when the flows through the chlorinator approached its design capacity of 50,000 U.S. gal/day.

It is believed that more efficient use of chemical can be achieved by installing a much wider weir plate when the chlorinator is used for higher flow rates.

Satisfactory destruction of sewage organisms was observed in all the samples of sewage chlorinated to a 15-minute chlorine residual of 0.5 mg/l.

The germicidal potency of SANURIL 115 was found to be comparable but no better than that of either calcium hypochlorite or sodium hypochlorite. There was no significant difference in the numbers of surviving organisms in the samples of sewage treated under similar test conditions with all three chemicals.

At an estimated cost of $0.95 per lb. the SANURIL 115 tablets may be considerably more expensive than other conventional methods of sewage chlorination particularly for larger plants. However, if the costs of chlorination are not important or if the chemical costs can be reduced to competitive levels, the SANURIL Wastewater Chlorinator can offer a favourable alternative for sewage chlorination because of its numerous advantages including simplicity of operation and limited maintenance requirements.

/pa/k

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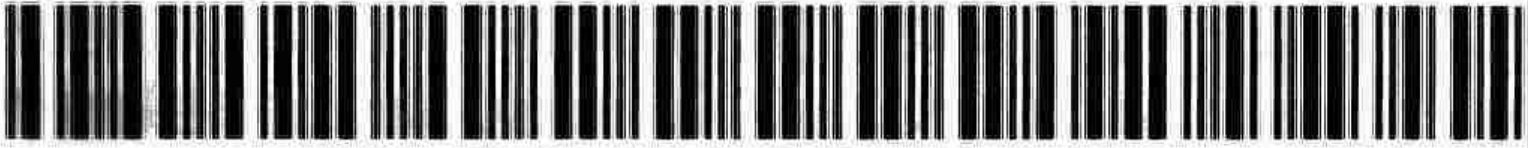
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